OFFUTT AIR FORCE BASE, GLENN L. MARTIN-NEBRASKA BOMBER PLANT, BUILDING D
(Glenn L. Martin-Nebraska Bomber Plant, Facility No. 301)
Peacekeeper Drive
Bellevue
Sarpy County
Nebraska

HAER NE-9-R
NE-9-R

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
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HISTORIC AMERICAN ENGINEERING RECORD

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HAER No. NE-9-R

Location:	Peacekeeper Drive, Offutt Air Force Base, Bellevue, Sarpy County, Nebraska
UTM:	254945.76E 4557128.34N
USGS Quadrangle:	Plattsmouth, Nebraska
Date of Construction:	March 1941 – October 1941
Architect:	Albert Kahn Associated Architects and Engineers, Detroit, Michigan
Present Owner:	United States Air Force
Present Use:	Due to its 540,000 square foot size, the building houses a large number functions for Offutt Air Force Base such as: Air Force Global Weather Central, the Fifty-fifth Strategic Reconnaissance Wing and Avionics Maintenance Squadron's Precision Measurement Equipment Laboratory, the 3902d Supply, Civil Engineering and Transportation Squadrons, the 3428th Technical Training Squadron, 544th Target Materials and Intelligence Exploitation Squadrons, and the 1000th Satellite Operations Group. In addition, the building houses a post office, printing plant, publication distribution office, barber shop, tennis courts, a wood shop and the Education Services Branch.
Significance:	In 1940, as the United States faced the prospect of its entry into World War II, the War Department authorized four new aircraft assembly plants, including the bomber plant built at Fort Crook (Offutt Airfield) near Bellevue, Nebraska. Built by Glenn L. Martin Company, the Aircraft Manufacturing and Assembly Building (commonly known as Building "D" or

Facility 301) is the largest and most significant industrial building within the Glenn L. Martin-Nebraska Bomber Plant, which included seventeen structures and two main runways. The structure is best remembered for the production of heavy bombers, including the B-26C (Martin *Marauder*) and B-29 (Boeing *Superfortress*), which were used with effectiveness during World War II. By the end of 1944, the facility was manufacturing more than fifty B-29s per month, including the secretly assembled and specifically equipped bombers *Enola Gay* and *Bock's Car* used to deliver and drop the world's first atomic bombs on Hiroshima and Nagasaki, Japan. The aircraft assembly building is also significant for its association with Glenn L. Martin and the aviation company that he founded. The Glenn L. Martin Company, renamed Lockheed Martin in 1995 after its merger with Lockheed Aircraft Company, designed the first mechanized conveyor system used to assemble the B-29. Noted modern industrial architect Albert Kahn, designed the enormous utilitarian structure, which measured 900' long and 600' wide when completed in 1941. Building "D" is one of the most important works of engineering and architecture in Nebraska and one of the most historically significant World War II era buildings in the United States.

Historian: Ted A. Ertl, Associate Professor of Architecture, and Sheila J. Ireland, graduate student of architecture, at the University of Nebraska-Lincoln.

Project Information: Following a 1994 cultural resource survey of historic properties at Offutt Air Force Base in Bellevue, Nebraska, the Glenn L. Martin-Nebraska Aircraft Manufacturing and Assembly Building was recommended as a property eligible for National Landmark status. Since the building continues in active use, the Nebraska State Historic Preservation Office and the Base Cultural Resource Manager determined that a history of the

building under the standards of the Historic American Engineering Record should be completed.

An initial tour of the building was conducted for the University of Nebraska-Lincoln, project team by Ed Lueninghoener, Chief, Environmental Management Flight, Offutt Air Force Base, on 23 May 2002. Photography was completed on 16 September 2002 by Roger Bruhn, a subcontractor of the University of Nebraska-Lincoln. Gregory D. Kendrick, Historian, and Tom Keohan, Historic Architect, both of the National Park Service Intermountain Support Office, Denver, Colorado administered the contract to complete the recordation project. Gene Svensen and Jean Coburn, Base Cultural Resource Managers, managed the project.

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Introduction

The Glenn L. Martin-Nebraska Bomber Building "D" is one of the most important works of engineering and architecture in Nebraska and one of the most historically significant World War II era buildings in the United States. The Martin Bomber Plant is the creative collaboration of two geniuses: the aviation pioneer Glenn L. Martin and the master of industrial architecture Albert Kahn. The genius was brought about by the necessity of supplying air power for the Allied Forces during World War II. The Martin Bomber Plant is a general development of Kahn's designs for automotive and other industrial factories and his design of Martin's Baltimore aircraft plant. The project was an outgrowth of the Knudson plan proposal to produce military aircraft as a collaboration between aircraft and automotive industries. In anticipation of entry into World War II, the War Department commissioned the construction of four aircraft plants to be built in the mid-west, far from existing strategically vulnerable coastal aircraft plants. The Martin plant was the most significant of these, producing the Martin B-27C and the Boeing B-29. Two B-29s, the *Enola Gay* and *Bock's Car*, manufactured at the plant were instrumental in bringing the war in the Pacific front to a quick end by dropping the first atomic bombs on Hiroshima and Nagasaki, Japan. During the "Cold War" era, the Martin-Nebraska Bomber Plant was converted into a missile manufacturing facility for the Strategic Air Command. The Martin-Nebraska Bomber Plant is significant to the story of American industrial architecture in the service of wartime military aircraft.

Description of the Martin-Nebraska Bomber Building

The Glenn L. Martin-Nebraska Bomber Plant is an industrial building complex constructed in 1941 for the production and modification of B-26C medium bombers and later adapted for the production of B-29 heavy bombers. Albert Kahn and Associates of Detroit designed the Bomber Plant for the Glenn L Martin Company of Baltimore. Peter Kiewit and Sons' Company of Omaha constructed it in collaboration with Paschen Contractors of Chicago.[1] Excavation, grading and site work was sub-contracted to George W. Condon Company of Omaha.[2] Miscellaneous wood frame construction was sub-contracted to Woods Brothers Construction Company of Lincoln, Nebraska.

EXTERIOR

The Glenn L. Martin-Nebraska Bomber Plant Manufacturing and Assembly Building "D" is an enormous two-story structure located to the north of the Fort Crook military parade ground on what was known as "hospital hill".[3] A railroad track spur approached the building from the main Chicago, Burlington and Quincy rail line to the northwest and circled the building on the east. The lower manufacturing level opened onto the north rail receiving dock while the main assembly level opened onto the south rail shipping dock.[4] Immediately beyond the spur was a perimeter service road. Finished aircraft emerged from the main assembly level at the southwest corner through a pair of canopy doors opening one hundred ninety-six foot wide by twenty-eight foot high onto a taxiway apron to the south.

Vehicular service entries were provided to the lower and main levels through overhead metal garage doors along the east side of the building. Workers also entered the building through metal doors at both levels on the east side. They approached the building crossing the rail tracks from a parking lot to the east that accommodated approximately 2,400 vehicles. Immediately north of the workers parking lot was one for administrative employees that accommodated an additional 400 vehicles. The Personnel Building "A", Protection Building "B", and Administration Building "C" were located to the north of Building "D". They were all connected by walkway bridges, which spanned a roadway

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[1] Kiewit and Pashon had collaborated on an earlier project in Chicago.
[2] George W. Condon Company specialized in heavy construction and road work.
[3] "Hospital hill" was so called because it had been the location of the Fort Crook military hospital.
[4] The building actually sits on the diagonal with the long sides oriented to the northeast and southwest. This report and the documentation drawings use the architectural plan convention of north and south to identify this orientation.

and the rail tracks, entering Building "D" at a mezzanine level. The Paint Shop was located to the west of Building "D". Aircraft Runway No. 1 was located to the south and Runway No. 2 to the east. Southeast of the runways were the flight and modification hangers.

The lower exterior walls of Building "D" were of reinforced poured concrete construction. They rose to a height of eight feet above the main level floor. Above that were five-foot tall horizontal bands of industrial steel sash with fixed and hopper windows, which alternated with gunite spandrel panels.[5] A blackout curtain track was installed near the top of the exterior walls. However, the specification was rescinded before the curtain was to be installed. Exterior flood lamps were installed about every fifty feet along the top of the perimeter walls and every twenty-five feet above the canopy doors. Ladders at the corners of the exterior walls provided access to the roof.

The flat roof was made of composite roofing material topped with tar and gravel. Seven pairs of skylight roof monitors[6] ran north-south providing light perpendicular to the production lines. Monitors over the rail docks ran east-west parallel to the tracks and dock. Shed roofs enclosed these monitors. An additional five pairs of monitors over the west end bay of the building ran east-west, perpendicular to the final production line, were enclosed with flat roofs. In systematic fashion, exhaust fan vents were located every twenty-five feet along the top of the monitors while roof drains were placed every fifty feet in the valleys between the monitors.

LOWER MANUFACTURING LEVEL

Construction of the lower and upper main level floors was poured in place concrete. Both floors were covered with wood blocks dipped in creosote and oil and set on end. This resilient flooring provided for worker safety and comfort. The lower level structure was comprised of twenty-inch diameter reinforced concrete columns with mushroom capitols placed on a twenty-five foot grid throughout. Columns were protected from abrasion and damage by four-foot tall steel plates at their base. Larger thirty-inch diameter columns supported the steel column structure of the upper level. Mechanical ducts passed through the larger column capitols to supply air to the upper level. Return air flowed through grilles in the upper level floor to ducts along the lower level ceiling.

[5] Gunite is a proprietary term for sprayed concrete, which was specified on the architect's plans.
[6] A roof monitor is a raised glazed area forming a continuous skylight on a factory roof.

Lighting was supplied by dual tube fluorescent lamp fixtures. These fixtures used ten miles of fluorescent light tubes. The press pit along the north wall was open to the floor above to accommodate the large machine presses. Eighteen stairways provided access for workers between the manufacturing and assembly levels. Wash basins and drinking fountains were located at the top and bottom of the stairways. Toilet rooms were located at the intermediate landings. Mechanical rooms and stairway walls were constructed of brick. Four open-cage elevators, three along the east wall and one on the south wall, and a vertical conveyor on the west wall were used to haul parts from the lower manufacturing level to the upper main assembly level.

MAIN ASSEMBLY LEVEL

Steel 16x11 1/2 wide-flange columns were placed on a fifty by one hundred foot bay grid. At the west end, the columns were on a one hundred by two hundred foot grid along the final production line. They supported twelve foot deep Pratt bridge trusses for the fifty foot wide spans and twenty foot deep Warren bridge trusses with vertical supports for the longer spans. The minimum clear height of the trusses was twenty-two feet, except over the final production line where it was twenty-eight feet high. A north-south expansion control joint with doubled columns and trusses was provided near the middle of the building and another adjacent to the two hundred foot bay of the final production line. Two-story wood frame structures for security, first aid, and various offices were disposed along the outer walls. Wood frame balconies were supported on round steel columns.

A link-belt pulley system along the floor pulled the aircraft slowly through the production lines.[7] Two turntables were provided to align the aircraft properly along the three production lines. The 180-degree turntable was located near the east end of the building between the first two production lines while the 90-degree turntable was located at the northwest corner of the building between the last two production lines. Hoists on tracks mounted below the trusses hauled sub-assemblies from their holding areas to the production lines. Ladders along the outside walls gave access to catwalks that ran along each light monitor window and provided passage to electrical panels and hoist cabs. High-bay reflectors with one-thousand watt incandescent lamps were located at

[7] Link-belt is a proprietary term for the horizontal pulley conveyor system used on the production lines.

approximately twelve foot intervals just above the bottom of the trusses throughout the main assembly level.[8]

ADDITIONS AND MODIFICATIONS

Two major additions were made to the building during the war in anticipation of conversion to B-29 production. A two hundred-foot wide clear-span wing assembly annex was constructed to the west in 1943. Designed by John Latenser and Sons of Omaha, this west annex maintained the same basic structural layout as final production line of the original building. It rose to a height of forty-four feet above the lower level floor to the underside of the trusses. Slightly different details included a one hundred fifty-eight foot wide by twenty-eight foot high sliding aircraft hanger doors opening onto a taxiway apron on the west. Another was the roof monitors, which were clad with asbestos shingles. A wood frame security balcony supported on round steel columns was located at the southeast corner of the annex. Access was gained from the main level of the original building.

The extension of a south rail dock annex was built in 1944. Designed by the Corps of Engineers it was substantially different in form, material, and structural system from the original building. It was constructed with reinforced concrete piers and concrete block walls. It was spanned with timber bow trusses forming a three segment vaulted roof. Wooden overhead garage doors provided rail and vehicular access to the south annex.[9]

A structural modification to the original building was necessitated to accommodate B-29 production. Two columns were shifted five feet at the northeast and soutwest corners of the east turntable bay to allow for clearance of the fuselage as it was rotated while being transferred between the first and second production lines. These columns carried makeshift steel beams above and conversely were supported by steel wide-flange columns angled to the base of the concrete columns in the lower level below.[10]

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[8] A complete inventory of Building "D" and its equipment was conducted by the Corps of Engineers in 1944. It is contained in "Facilities Inventory, A-A-Plant, Fort Crook, Nebraska" and "Addendum No. 1 to Facilities Inventory, A-A-Plant, Fort Crook, Nebraska" located at the 55th Wing Archives.

[9] These structural changes were due to the shortage of steel and other building materials during the war.

[10] Numerous other modifications to the original building accrued over the decades since the Martin Bomber Plant reverted to the military at the end of the war.

Glenn L. Martin

Martin was raised and educated in the central Kansas town of Salina. There he was exposed to basic mechanics through his father's hardware and farm implements shop and his own experience working in carriage and bike shops. He left high school after his sophomore year to take courses at Kansas Wesleyan Business College in Salina.

In 1905, Martin moved with his family to Santa Ana, California. Here Martin opened a Ford and Maxwell car dealership and garage. The business was successful enough to allow Martin resources to build a glider from commercially available plans. It was not long before he unsuccessfully attempted motorized flight by bolting a Model N Ford engine to the glider.[11] By 1909 he became the first man to fly in the state of California and the fourth in the country.[12] Most flying machines at this time were modifications of machines produced by either the Wright Brothers or Glenn Curtiss. Martin's design was similar to the Curtiss *June Bug* biplane.

Martin made his first public flight in 1910 at the Santa Ana, California "Carnival of Progress". Martin flew in air shows from 1910 until 1917 when potential investors insisted he give up flying altogether. Martin's stunt flying accomplished three purposes. First, it promoted the Martin name. Second, it provided a vehicle through which he could exchange ideas with other participants in the fledgling industry. Finally, it allowed him to demonstrate to possible investors the potential of flying machines with exhibitions such as fantasy air raids on "forbidden cities." "This show and others like it accomplished its purpose—it attracted the attention of the War Department," Martin recalled thirty years later.[13]

Throughout his barnstorming career, Martin never stopped improving his aircraft and publicizing its potential uses. Martin incorporated his business on August 16, 1909 as the

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[11] Wayne Biddle, *Barons of the Sky*, (New York: Simon and Schuster, 1991), 47. Information on Martin and his career is taken from this source unless otherwise noted. A dedicated biography of Martin has yet to be written. Most aviation history books focus on technological advancements in flight and dedicate little more than a paragraph or two to Martin, often simply regurgitating myths created by Martin himself. Since Biddle's focus is on the progenitors of the industry, he offers an insight into Martin's personality and career that is nonexistent in other sources.

[12] John S. Garaty and Mark C. Carnes, editors, *American National Biography* (New York: Oxford University Press, 1999), 593-594.

[13] Biddle, *Barons of the Sky*, 56.

Glenn L. Martin Company. Martin used the proceeds from his publicity flights to fund development of a "new tractor-type biplane (a plane which uses a front mounted engine to pull the craft rather than a rear engine to push the craft) designed by William Stevens, chief of his mechanics."[14] In 1912, Martin set a record in a modified hydro version of the tractor type. He flew the farthest distance over water to date, 34 miles from Newport Beach to Santa Catalina Island and back.[15]

In early 1913, Martin opened his first true assembly building, a 16,000 square foot plant in Los Angeles. This was in addition to his aircraft hangar, "a testing site on Balboa Island, and a school for hydroplane flying in East Newport."[16] In the same year Martin received patent #1,165,891 for his design of a packed parachute. He also did his first work for the war department, an armored version of his tractor plane in which both pilot and engine were protected by a completely enclosed fuselage. Shortly afterward in 1914, the Signal Corps banned all use of the Wright style, rear engine, "pusher" type planes because they considered them too dangerous. The rear engine could too easily crush the pilot in a rough landing. This put Martin at a considerable advantage as he and Glenn Curtiss were the only significant manufactures of front-engine planes at the time. "The Signal Corps decision turned him from a struggling second-tier builder into a prime source. The Army ordered seventeen Martin Tractors, in 1914 alone, at a base price of $8,500 each."[17]

Throughout his career, Martin made prophetic predictions. One of his earliest was documented "in the *Los Angeles Evening Herald* of August 7, 1914--three days after the German invasion of Belgium--under the headline 'Aviator Tells of New Terrors for Armies and Navies.'" Martin stated "the aeroplane will practically decide the war in Europe. Veritable flying death will smash armies, wreck mammoth battleships and bring the whole world to a vivid realization of the awful possibilities of a few swift winging aerial demons."[18] He was describing the dominant role of aircraft in warfare to come, including World War II.

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[14] Ibid., 59.
[15] Garaty and Carnes, *American National Biography*, 593-594. Lockheed Martin Corporation official website, 2002, www.lockheedmartin.com, "about us" link, "history" link.
[16] Biddle, *Barons of the Sky*, 61.
[17] Ibid., 65.
[18] Ibid.

With war in Europe encouraging aircraft development, Martin hired his first academically trained engineer, Donald Douglas. Douglas went to work on the Martin Tractor which had already been through several iterations including models T and TT. Douglas' S version was the biggest aircraft yet produced by Martin. "Its wingspan was thirteen feet longer than the TT military tractor, it was more than twice as heavy, its flying radius was rated at 500 miles versus 350, and its air speed fully loaded was only a bit slower. At about $12,000 a copy, it was also 50 percent more expensive than the TT."[19] The Signal Corps bought four of them in 1915. The arrival of trained engineers into the field marked the beginning of a new era of development. With engineers on the job, development went from trial and error to the more efficient method of designing on paper.[20]

In July, 1916, the British used aircraft successfully against the Germans in the battle of the Somme. In August, 1916 Congress passed a bill for the largest army appropriation of aircraft to date, $13,281,666. The navy received an additional $3,500,000. The Glenn L. Martin Company was purchased by the Wright Company that same year to form the Wright-Martin Aircraft Company.

The merger meant greater opportunity to develop competitive aircraft. Unfortunately the company turned its attention and capitol to developing engines, rather than frames, which was Martin's business. Both Wright's Dayton and Martin's California plants were closed as a result. With no frame development to speak of, Martin grew restless.

In 1917, he found a new group of investors, and reestablished the Glenn L. Martin Company in Cleveland, Ohio. Martin began to develop a new plane for the Signal Corps, "a twin engine fighter-bomber designated MB-1."[21]

Less than a month after the Army requested fifty MB-1s the war ended and the order was cut to four. The Army was still interested in the development of the MB-1 as a bomber--which kept Martin's investors happy during the post-war downturn of 1920. Martin also gained an important ally in the military, General Billy Mitchell, an advocate of military aircraft, and an independent air force.[22]

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[19] Biddle, *Barons of the Sky*, 86.
[20] *History Timeline*, "1940-2000". Lockheed Martin Corporation. Internet on-line. Available from <http://www.lockheedmartin.com/about/history.html>. [14 August 2002].
[21] Biddle, *Barons of the Sky*, 106.
[22] Ibid., 119.

Continued development of the MB-1 resulted in the MB-2 that was made famous by a bombing demonstration staged by General Mitchell to show how effective bombers could be against enemy warships. After placing an initial order with Martin for twenty units, the Army opened production of the airplane to bid and further production was awarded to two of Martin's competitors, Lawson, Willard and Fowler Company and Curtiss. It would be thirteen years before Martin produced another airplane for the Army. In the meantime he found customers in the Navy and foreign markets.[23]

By 1924 the company developed the Martin SC-1 bomber for the Navy. This plane would become "the forerunner to more than 300 subsequent Martin bombers."[24] It was production for the Navy that led Martin to seek a new location for his plant to save on shipping costs and to be close to his federal clients. In October 1928, Martin sold off his Cleveland plant and formed a partnership with Louis Chevrolet who owned the design of an engine which Martin thought promising. The newly reformed Glenn L. Martin Company in an area just east of Baltimore called Middle River had a new state-of-the-art aircraft production facility to be designed by the nation's top industrial architect, Albert Kahn.

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[23] Ibid., 140.

[24] *History Timeline.* "1940-2000." Lockheed Martin Corporation. Internet on-line. Available from <http://www.lockheedmartin.com/about/history.html>. [14 August 2002].

Albert Kahn

Albert Kahn was born in Germany in 1869 and immigrated to Detroit, Michigan, with his family in 1880.[25] Kahn went to work full time as an architectural apprentice for the Detroit firm of Mason and Rice.[26] In 1896 Kahn started a partnership with George Nettleton and Alexander B. Trowbridge. In 1897, Trowbridge left the partnership. The partnership of Nettleton and Kahn practiced until Nettleton's death in 1900 after which Kahn reunited briefly with George D. Mason before beginning his own firm in 1902.[27] Kahn did business under the name of Albert Kahn, Architect and Ernest Wilby, Associate until 1918. At this time the name of the firm changed to Albert Kahn Associates, the name retained until Kahn's death in 1942.[28]

It was his automotive and military production plants made Kahn recognized. Throughout his career, Kahn designed offices, showrooms or plants for each of the big-three automotive manufactures: Ford, General Motors-Buick and Chrysler-Plymouth-Dodge. Additional automobile clients included Hudson, Packard, Fisher, Pierce and others. Kahn designed two significant plants for Ford, each comprised of several buildings. The first was at Highland Park, Michigan (1909-13), the second at Rouge River, Detroit (1917-25). By 1925 the Rouge River plant had become the largest industrial plant in the world.[29]

Kahn's automotive plant experience and associations led to his work on production plants for the U.S. military and aviation industries. One of Kahn's first military commissions was the design of the Ford Eagle Plant at Rouge River (1917). The plant housed the production of Eagle Submarine Chasers for the U.S. military using his assembly-line methods.[30] Kahn's first aviation building was designed for the Glenn L. Martin Company

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[25] Detroit Institute of Arts, *The Legacy of Albert Kahn* (Detroit: Detroit Institute of Arts, 1970).
[26] Grant Hildebrand, *Designing for Industry: The Architecture of Albert Kahn* (Cambridge: Massachusetts Institute of Technology, 1974).
[27] Detroit Institute of Arts, *The Legacy of Albert Kahn* (Detroit: Detroit Institute of Arts, 1970).
[28] Hildebrand, *Designing for Industry*. Sources differ on the name or names of Kahn's firm. Editor Randall Van Vynckt's *International Dictionary of Architects and Architecture*, vol. 1 (Detroit: St. James Press, 1993) uses the name Albert Kahn, Inc. on page 453. *The Legacy of Albert Kahn* uses the name Albert Kahn Associates except in the Epilogue (p. 184) where it uses Albert Kahn Associates, Inc. It is likely that the firm incorporated after Kahn's death and changed the name accordingly.
[29] Detroit Institute of Arts, *The Legacy of Albert Kahn*, 23. Hildebrand, *Designing for Industry*, 43-54, 92-120.
[30] Hildebrand, *Designing for Industry*, 92-99.

in Middle River, Maryland (1929). This marked the beginning of a twelve-year relationship between Kahn and Martin which resulted in three plants totaling over 3.25 million square feet.

Kahn could be considered a pioneer of industrial architecture. "Few architects regarded factory design as a suitable challenge to their abilities early in the 20th century."[31] Kahn was an ongoing innovator of effective solutions to the challenges inherent in plant design: lighting and ventilating the production floor, allowing for flexibility in the production process, designing inexpensive yet durable and attractive plants, and speed of construction.

Most of Kahn's competitors used single sided, north-facing monitors for lighting in their factory designs. This orientation had the advantage of providing consistent light, without the heat gain associated with direct east, west or south light. The disadvantage was that shadows result from a single light source, effecting both productivity and flexibility. A plant administrator faced with such lighting would have to take shadows into account when designing the layout of production lines. The first plant in which Kahn experimented with monitor lighting was the "Geo. N. Pierce plant of Buffalo, New York, built in 1906 for the manufacture of the Pierce Great Arrow."[32]

In this plant, both single and double-sided monitors were used. The monitors on the Garage, Brazing Building and Power House were multi-directional with vertical glazing facing north and south.[33] Although designs varied from those at Pierce, nearly every subsequent single-story plant design made use of multi-directional glazing. The Packard Forge Shop (1920) was another example of Kahn's use of operable glazing for ventilation. Ventilation was critical in plant design during an era which predated air conditioning.[34]

Production innovations at the turn of the century happened so quickly that poorly designed plants just as quickly became obsolete. The Ford Plant at Highland Park,

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[31] Randall J. Van Vynckt, ed., *International Dictionary of Architects and Architecture*, vol. 1 (Detroit: St. James Press, 1993), 453.
[32] Hildebrand, *Designing for Industry*, 34.
[33] Ibid., 36-37, 40 provide excellent photos of the plant along with a site plan.
[34] Ibid., 57 shows a section of the building illustrating Kahn's careful study of light distribution and ventilation patterns.

Michigan (1909) for example, was designed by Kahn for the production of Ford's Model T. At the time Ford was using a gravity-driven assembly line. This made the best solution a multi-story facility. This method became obsolete with Ford's "introduction in this same plant of the powered moving assembly line. Within five years of the opening of Highland Park, Henry Ford would turn his thoughts to a new manufacturing complex, and within seven years the company would embark on a policy of one-story buildings to the virtual exclusion of the multistory scheme."[35]

Just as his relationship with Ford put Kahn in the right place at the right time, Kahn's collaboration with his brother Julius provide him with the right tools for the job.

In 1903 Julius Kahn, a civil engineer, joined Kahn's firm as chief engineer. Julius immediately collaborated with his brother on the Engineering Building for the University of Michigan. "This experience made Julius aware of the weakness of the empirical system of reinforcement. After making conclusive tests, he designed a system of reinforcement based on scientific principles."[36] The result was the Kahn trussed bar which was patented in 1903. In the same year Julius started the Trussed Concrete Steel Company as a separate business.[37]

Kahn saw that the single story plant type had the best potential to meet the needs of Ford's powered moving assembly line. Multistory facilities were restricted in both height and in base area (footprint). Height was restricted due to structural and practical limitations and footprint due to natural lighting limitations (side lighting can only penetrate so far into the interior of a building). The single story concept suffered from neither of these limitations. Overhead monitors could be used to light a plant with a footprint that covered an unlimited amount of area. In the single story scheme, the only limitations to complete flexibility of the production line were the columns which held up the roof. Columns took up valuable floor space. The design challenge for the new single story factory would be finding the perfect balance between size and number of columns. This challenge eventually led Kahn away from reinforced concrete construction in favor of steel construction which allowed for smaller diameter columns. Steel's advantages

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[35] Hildebrand, *Designing for Industry*, 45, 51.
[36] Detroit Institute of Arts, *The Legacy of Albert Kahn*, 10-11.
[37] *The National Cyclopaedia of American Biography*, vol. 33 (New York: James T. White & Company, 1947), 36. The name of the company was subsequently shortened to Truscon and then changed again in 1918 to the Truscon Steel Company.

were that it required no forms, no curing time, and little concern for weather conditions. A steel structure could also be erected much more quickly than concrete.

Ford's new manufacturing complex was begun at the Rouge River, southwest of Detroit, in 1918 for the manufacture of boats. U.S. involvement in World War I gave Ford the opportunity to prove the adaptability of his assembly line innovations to uses outside of the automotive industry. The resulting government financed Eagle Submarine Chaser plant, at 255' x 1,700', was the largest yet designed by Kahn. It consisted of 5 51' bays 1,700' in length. Each bay was illuminated by double sided monitors. The center and two outer bays were used for assembly of the boats. The other two bays supplied the assembly material brought into the north end of the building on railroad tracks which continued through to the south end. The southern most 400' of the building had a clear height of 50' 9" to accommodate the nearly completed boat assemblies which exited at the south end through 40' high rolling doors. The rest of the building had a clear height of 30' 8". Flanking the east and west lengths of the manufacturing area were 26' wide aisles housing support areas (like rest rooms, cafeteria, etc.). The support areas were constructed from wood so they could be easily demolished for future expansion of the manufacturing floor. The rest of the building used all steel construction with brick and asbestos steel cladding.[38]

Kahn's response to the anticipation for expansion had as much of an impact on his design aesthetic as did his responses to lighting needs and the need for an efficient structural system. Unlike classically designed buildings, Kahn's factories were typified by the lack of any single prominent feature to define either symmetry or asymmetry. He used no decorative or structural definition at the corners to suggest a beginning or an end. Buildings like the Eagle Plant consisted of one or two simple bay structures which were extended or repeated in any direction to infinity. This was modern architecture in its simplest form. Most manufacturing plants were actually made up of any number of buildings housing support functions for the manufacturing process which actually occurred in only one or two of them. Examples include foundries, office space, boilers, subassembly manufacture, and so on. Thus the expansion of the manufacturing capacity meant a great deal more than simply increasing the size of the main manufacturing building. Kahn was just as adept at designing flexible site plans as he was at designing flexible buildings. At the Rouge River Plant site "all major rail and street lines...run

[38] Hildebrand, *Designing for Industry*, 92-93, 99.

north-south, and major process lines in all buildings from the Eagle Plant onward are oriented north-south, providing a basic relationship among all buildings" that can be repeated and expanded as long as there is land on which to build.[39]

Ford's Rouge River complex, and the Eagle Plant in particular, are discussed here because they so clearly explain the reasons behind Kahn's design aesthetic, what set him apart from his contemporaries, and how he contributed to modern architecture. The Eagle Plant "enclosed an immense and complex manufacturing operation within a simple, direct, and economical plan configuration; it marked a major manufacturer's commitment to one-story construction; it was therefore framed in steel, marking the turning of industrial architecture toward light, steel-framed, thinly clad enclosures; and finally, as a result of steel structure, it was built with remarkable speed."[40] The Eagle Plant also illustrated Kahn's ability to design flexible spaces that were customized to meet the immediate needs of the production line. Kahn admitted to employing a "design formula" in his work. He believed that such an approach permitted him to focus his greatest attention on the unique design challenges of a given building without wasting time on problems solved in previous projects. Using this approach Kahn never stopped searching for the perfect solution to the individual design problems of industrial buildings.[41] By the late 1930's Kahn's office had reached its peak with a staff of over 600 producing designs for nearly 20 percent of every architect designed factory in the nation.[42]

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[39] Ibid., 45, 51.
[40] Ibid., 99.
[41] Ibid., 164.
[42] Adolf K. Placzek, ed., *Macmillan Encyclopedia of Architects* (The Free Press, New York, 1982), 535.

Martin's Baltimore Plant

"Kahn's first aircraft manufacturing plant lived up to his reputation. It was a deluxe edifice..., with individual electric drives for each tool instead of a noisy, dangerous overhead belt system, and floors constructed of expensive wooden blocks" which were more comfortable for workers than concrete floors. By October 1929 Martin "and some 250 employees moved into a 298,000 square-foot plant accurately described as the most modern airplane manufacturing hall in the world."[43]

Less than a month after occupying his new facility, the stock market crashed on October 29, 1929, creating a depression that would put his business at serious risk for the next five years. In 1930 Martin made just enough on the sale of thirty seaplanes to the Navy to stay in business and to continue the company's work on development of a new high-speed bomber for the Army. The bomber that Martin was developing would become the B-10, the fastest bomber yet designed. Its top speed of 200 miles per hour approached twice that of existing bombers. In 1933 Martin was awarded the Robert J. Collier Trophy for the design and the Army ordered forty-eight B-10s.

By 1935 Martin was back on his feet again with development of the M-130, China Clipper, used by Pan Am to fly passengers across the Pacific. A large order from the Army along with increasing foreign orders helped insure that the Glenn L. Martin Company would remain at the top of the aviation game.[44]

The rest of the decade was a pre-war boom in the aviation industry. Foreign orders, especially for the B-10, increased steadily from 1934 to 1941 and the United States, not wanting to repeat the mistakes of World War I, also stepped up orders for Martin's seaplanes and other aircraft. "At the end of the first quarter of 1937, the company's surplus was $6.036 million. By the end of the year, there was a $17.6 million dollar backlog, with exports accounting for 62 percent of it."[45] Martin's huge Middle River facility was suddenly not big enough.

In 1937 the Kahn designed addition to Martin's Middle River facility was under way. Scheduled for completion in November, it would double plant capacity. The addition was

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[43] Biddle, *Barons of the Sky*, 164.
[44] Garaty and Carnes, *American National Biography*, 594.
[45] Biddle, *Barons of the Sky*, 241.

an engineering marvel. Even though the B-10s the plant was currently producing had wingspans of just over 70', Martin anticipated that wingspans would be three times that length in the near future.[46] Because of this, Martin asked for a 300' span of column free floor space. Kahn designed the world's longest flat span truss ever used in a building. Heretofore, such lengthy flat spans only existed in bridge construction. Buildings with equivalent spans used arched trusses. Kahn was the first architect to incorporate bridge engineering techniques into a building. The result was a column-free area of an unprecedented 300' x 450'[47] Three independently operating bay doors could open and close separately or together to form a 300' unobstructed opening in the side of the building.

Another 1937 development was the first power-operated revolving gun turret which would be used on more than a dozen types of American and Allied aircraft during the war.[48] This was also manufactured at the Middle River plant. Building "B", the 1937 addition, was followed just two years later by the Kahn designed addition known as building C, bringing total plant floor space to 25 acres. The $1,800,000 addition was constructed in record time, only seventy-seven days. It was built primarily to cover "an $11 million order from France for 115 B-10 derivatives called the A-22."[49]

The threat of war brought another unprecedented event. In 1939, the Army placed its largest aircraft order to date for 201 Martin B-26 Marauders straight off of the drafting table with no prototypes constructed. The result was a plane that was actually developed during the manufacturing process--an example of why Detroit's mass production methods did not work in the aircraft industry. Even before production began, changes were being made to the design as a result of information gathered from experience with other combat planes. Due to such changes, Martin had an additional four months to begin production.

In the meantime Martin continued to receive more foreign orders for versions of the B-10. By the fall of 1940, before the first B-26 was finished, the Army increased its order to an additional 990 B-26s in response to Roosevelt's 50,000 plane program. In November the first B-26 was wheeled out of the Baltimore plant and flown. However the

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[46] Museum at Wright-Patterson AFB, Dayton, Ohio official website, 2002, www.wpaf.mil/museum/early_years/ey.htm.
[47] Garraty and Carnes, *American National Biography*, 332.
[48] *History Timeline*, "1940-2000," Lockheed Martin Corporation.
[49] Biddle, *Barons of the Sky*, 265.

amount of outstanding orders for the plane, led Martin to take advantage of a government sponsored financing program to build a dedicated B-26 production plant next door to his existing Middle River facility.[50]

Plant No. 2, as it was known, doubled the size of the existing facility at a cost of $25 million dollars.[51] Its high ceiling, large-span assembly area (located in the center of Plant No. 1) was moved to the end of the plant, positioned at a right angle to the lower-roofed subassembly area. This established a production flow which moved from small parts at one end of the building to finished assemblies at the opposite end, an arrangement typical of many of Kahn's automotive plants.[52]

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[50] Glenn L. Martin Aviation Museum official website, 2002, www.martinstateairport.com/museum/aircraft/ch_15.htm.

[51] Biddle, *Barons of the Sky*, 283.

[52] Jack Breihan, Department of History, Loyola College, Maryland, letter to coauthor Ted A. Ertl, 19 August 2002. The letter briefly describes the differences between the two plants and includes a production layout for Plant No. 2.

The Knudsen Bomber Plant Program

Following World War I, the government increased aircraft manufacturing capacity for wartime production using automotive plants. The aircraft industry was hesitant to train what they saw as their post-war competition. In addition, aircraft manufacturers claimed that automobile plants did not have adequate clearance to accommodate the large wing spans of aircraft. Because of this, in 1938, the Air Corp decided that automobile manufacturers "would serve only as subcontractors providing...parts and subassemblies" to established aircraft frame manufactures who, acting as prime contractors, would assemble the finished aircraft.[53] This decision, however, brought the country only one step closer to solving the problem of wartime production capacity.

Memories of the depression following World War I still fresh in their minds, aircraft manufacturers were extremely hesitant to endorse any type of federal aircraft procurement policy that would require them to finance the expansion of their facilities beyond peacetime capacities. Martin was no exception having been burned on the MB-1 in 1918. Companies were not willing to risk long term losses for the possibility of short-term gain. Since there was no way to predict how long the war would last, or how much production would ultimately be required, businesses could not be sure that even wartime production levels would be sufficient for them to recoup on the expense of new or expanded facilities.[54] A strictly capitalist aviation economy simply would not generate a supply sufficient to meet wartime demand. The government needed a plan that would prevent increased wartime production from becoming a peacetime liability for aircraft manufacturers.

One solution was to allow aircraft manufacturers special consideration for the depreciation of the new facilities and the equipment housed within them. This was known as the "rapid depreciation provision" and, despite some initial red tape, it became widely used, mostly for manufactures outside of the aircraft frame production industry.

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[53] Irving Brinton Holley, Jr., *United States Army in World War II, Special Studies, Buying Aircraft: Materiel Procurement for the Army Air Forces* (Washington, D.C.: Office of the Chief of Military History, Department of the Army, 1964), 290. Unless otherwise noted, all information in this chapter is cited from this source.

[54] The aircraft industry was not being unpatriotic. The uncertainty of wartime production was a fact. Martin was nearly bankrupt after World War I when the Army reduced its order of fifty MB-1s to four. In November 1938, the call was for 10,000aircraft; in 1938 it was reduced to 5,500. By May 1940, the call was for 50,000 aircraft. Holley, *Buying Aircraft,* 291.

Another solution was the Emergency Plant Facility (EPF). The EPF called for the manufacturer to undertake construction of whatever type or size of facility they deemed necessary to meet their production requirements. "For its part, the government would agree to buy back the facility from the contractor with a series of equal payments spread over sixty months."[55] Unfortunately the banking community made this option unpalatable by adding unrealistic safeguards to the necessary financing agreements. As a result only two of the original eleven EPF plants were ever built, Ford's Dearborn plant and Martin's Plant No. 2 at Middle River. The other nine "were either canceled, amended or converted to other types of contracts."[56]

Perhaps the most widely used production expansion method was the Defense Plant Corporation (DPC). Manufacturers in need of expanded facilities could apply to the DPC for financing. If approved, the DPC would finance construction of the facility and then lease it to the manufacturer. By the end of the war 935 plants were constructed through the DPC.

Of all the plans purposed during the two years before the United States entered the war only one was designed to form a cooperative effort between the aircraft industry and the automotive industry. This was the plan by William Knudsen commissioner of production for the National Defense Advisory Commission (NDAC). The President had formed NDAC to coordinate the armament effort prior to officially entering the war. The armament plan that had been worked out by the government after World War I called for supervision of production by a civilian committee tentatively dubbed the War Resources Administration (WRA). However, mobilization of a WRA was only planned for wartime and the United States was not yet at war. Moreover the isolationist political environment at the time made it unrealistic to advocate the prewar organization of a WRA. Thus was born the NDAC. It would perform the coordination tasks until an actual WRA could take over when and if the United States entered the war.[57] Knudsen, of General Motors, served as commissioner of production. Also represented were leaders from the steel industry, labor organizations and other industries related to the war effort.

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[55] Ibid., 298.
[56] Holley, *Buying Aircraft*, 299.
[57] In December 1940, Roosevelt replaced the NDAC with the Office of Production Management (OPM). After Pearl Harbor, when the United States had officially entered the war, the OPM was replaced by the War Production Board, the agency which would officially occupy the role planned under the name War Resources Administration. Holley, "Organizing for Production," *Buying Aircraft*, 247-273.

The Bomber Plant Program, or Knudsen Plan, called for the construction of two government furnished bomber plants to be operated by aircraft manufacturers acting as prime contractors for the assembly of bombers. The automotive industry formed the Automotive Committee for Air Defense, with members including representatives from the big three, manufacturers: Ford, Chrysler and General Motors. The committee divided the task "into four equal parts. Approximately 25 percent of the work would involve fabrication of parts. Making subassemblies would account for another 25 percent. These two jobs would be the responsibility of the automotive industry. The manufacture of fuselages would take up another 25 percent, which, coupled with the installation of parts and final assembly" would be handled by the aircraft industry.[58] The automobile industry also gave the aircraft manufacturers assurance that they would not become competitors in the post war economy. Yet to be decided was which bombers the plants would manufacture and where they would be located. The answers to these questions would be in the hands of the Army Air Corps.

The War Department had always been uncomfortable with the way the aircraft industry was concentrated on both coasts, making it vulnerable to attack. The industry argued that locating plants too far from suppliers and the parent company would slow down production and increase costs. With the Detroit based automotive industry participating in the manufacturing process, the distance argument lost some of its strength, it was labor that was the deciding factor.

The labor markets surrounding existing plants on either coast were saturated. Any available labor would soon be absorbed by plant expansions, like Martin's. Labor was the factor that caused the Air Corp to decide on four plants rather than two. A plant requiring 20,000 employees would put a strain on the infrastructures of even the largest Midwestern cities. Four plants employing about 10,000 people was a more realistic solution.

The four separate locations would need to have adequate labor and an adequate infrastructure, or the ability to create one, as well as adequate transportation lines for the shipment of supplies. They would also need to be at least 200 miles from any U.S.

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[58] Holley, *Buying Aircraft*, 306.

border or coastline so if one production area was attacked, the others could continue to operate.

Omaha fit these specifications. It had sufficient population, mostly native-born, which the Army believed made them more likely to be patriotic and less to be saboteurs. It was a hub for both Union Pacific and Burlington. Plus it had a crossing over the Missouri River for accessibility to eastern suppliers. Bellevue's Fort Crook was an added bonus. Locating a plant at a military fort meant added security, and it meant that the government would need to purchase little or no land.

At the end of 1940 Fort Crook, Bellevue, Nebraska was chosen one of a chain of Midwestern plants, including Kansas City, Kansas; Tulsa, Oklahoma; and Fort Worth, Texas. Each plant was to be large enough to accommodate assembly of the largest aircraft designs being considered for production, the XB-29 and the XB-32, even though immediate plans called for assembly of medium bombers only at the Nebraska and Kansas plants.

On February 14, 1941, the Glenn L. Martin Company contracted with the United States government for the construction and operation of the Fort Crook plant which would assemble the Martin B-26 Marauder, a medium ranger bomber. Subassemblies for the B-26 would include the front section of the fuselage by Chrysler; the rear portion of the fuselage by Hudson; and wings by Goodyear.[59]

[59] Jacob Vander Meulen, *Building the B-29* (Washington, D.C.: Smithsonian Institution Press, 1995), 69.

The Martin-Nebraska Bomber Building

CONSTRUCTION OF THE ASSEMBLY BUILDING AND PLANT

The design and construction of the facility was the responsibility of the Martin Company. Martin began negotiations with Albert Kahn through Omaha District U.S. Engineer, Major Helmer Swenholt, in December 1940. By February, 1941, negotiations for the construction contract were also under way.[60]

On February 15, 1941, Peter Kiewit and Sons' Company was given a "start work" order for the Glenn L. Martin-Nebraska Bomber Plant by Washington's War Department. They were awarded the construction contract along with their associate, Paschen Contractors, Inc. of Chicago. Major subcontracts were let to the George W. Condon Company of Omaha for site preparation and grading, and Woods Brothers Construction Company of Lincoln, Nebraska, for miscellaneous wood frame construction. Kiewit and Paschen would handle building construction while Condon and Woods took care of the site preparation and materials acquisition.[61] By the time the overall government contract was finalized, the design-construction team was assembled and ready to begin work.

On March 3, 1941, at the ground-breaking Martin announced that he had a letter of intent from the U.S. government authorizing him to begin production of 1,200 B-26C Bombers in Nebraska.[62] Such letters of intent allowed work to begin before an official contract was drawn up and signed.[63]

The new plant was to consist of nine buildings: the 600' x 900' two story manufacturing and assembly building supported by a die cast shop, oil storage building, boiler house, employment building, engineering building, warehouse and two hangars.[64] The plant was to be built on 503.85 acres of Fort Crook land which was leased to the Martin-Nebraska

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[60] George A. Larson, "Nebraska's World War II Bomber Plant: the Glenn L. Martin-Nebraska Company", *Nebraska History*, vol. 74, no. 1 (spring 1993): 34; "History of the Glenn L. Martin-Nebraska Company" (55th Wing Archives, Offutt Air Force Base, Nebraska), 13; and "Early Years," "Depression Era," "Military Buildup." *Kiewit and Sons', Inc., Kiewit Company History.* Internet on-line. Available from: <http://www.kiewit.com/about/history.html>. [2 Nov. 2002].

[61] Ibid.

[62] "History of the Glenn L. Martin-Nebraska Company." 15.

[63] Holley, *Buying Aircraft*, 257.

[64] "Bomber Plant Construction Start Seen in 6 or 8 weeks; Cut Red Tape". *Omaha World Herald.* 23 December 1940.

Company along with all of Fort Crook's flying facilities. An additional 96.09 acres were purchased to expand Fort Crook to a size of 641.76 acres including the plant site.[65]

Prior to construction of the plant the site was known as Hospital Hill. It included, not only the fort's hospital, but "three double units of officers family quarters, the post golf course, the NCO Club, and the post headquarters." All had to be demolished.[66] The hill itself was leveled to accommodate the large flat areas required by the plant. By April 17, concrete was poured for the first footings of the Manufacturing and Assembly building. By June 18, 1941, the first pieces of structural steel were set into place.[67]

The structural steel contract for all of the plant buildings was awarded to Omaha Steel Works on March 13, 1941.[68] Fabrication of steel for the assembly building was by Omaha Steel Works, Paxton and Vierling Iron Works, also of Omaha, and St. Joseph Steel Works, of St. Joseph, Missouri. Steel for support buildings was fabricated by the Pittsburgh-Des Moines Company and Des Moines Steel Works, both of Des Moines, Iowa.

On June 27, Martin's letter of intent became an official contract for the production of 1,200 B-26C Marauders. The contract stated that the new plant was to be ready for production by January 1, 1942. Martin planned to have construction complete by November, 1941.

Construction of the assembly building was complete by October 14.[69] A November 17, status report showed the following completion percentages for the plant as a whole: design, 98.5 percent; construction, 89 percent; flying field, 76 percent; equipment ordered, 91 percent; equipment received, 35 percent; whole project, 85 percent.[70] The small percentage of equipment received was an ongoing problem that caused delays in completion of the plant and in its operation.

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[65] "Chronology of Fort Crook," entry for 1940.
[66] P. Spickermann, ed.. "History of Building 'D'," 30 May 1984 (OAFBP 210-1, Offutt Air Force Base, Nebraska), 3.
[67] "History of the Glenn L. Martin-Nebraska Company," 28.
[68] Ibid., 18.
[69] Ibid., 31-32; and Spickermann, ed., "History of Building 'D'," 4.
[70] Ibid., 49. Percentages listed refer to the entire plant, not just the Assembly Building.

On December 10, the Martin Company was authorized to occupy the plant. The Production Planning Department moved into the plant on December 15. By December 31, only ten months after ground breaking, the plant was 99 percent complete and the U.S. Corps of Engineers transferred control of the plant to the Air Corp.[71] As many as 2,500 men working three shifts constructed the plant.[72] Total cost of construction for the assembly building alone was $10,775,395.[73]

PRODUCTION AND EQUIPMENT COORDINATION

Even though construction of the assembly building met the government's January 1, 1942 deadline, the equipment delays made operation of the plant by the same date impossible. Martin's Nebraska plant and the three other Knudsen bomber plants being built in Kansas, Oklahoma and Texas were a fraction of all the war related construction occurring throughout the country. Construction equipment suppliers and subassembly suppliers were expanding their facilities to meet the demands which put an even greater strain on material supplies.

In an effort to facilitate the flow of high demand materials, the government set up a complex priority system through Wright Field. One had to apply for priority status to get the materials and equipment needed. Naturally every other concern with a project deadline wanted the same high priority rating. By January 1, only 50 percent of the required machine tools were at the assembly building. "A list of all undelivered critical tools was compiled on this date and forwarded to Wright Field with a request that the delivery of these items be expedited."[74]

With insufficient tools and equipment, some production work was possible on subassemblies for the B-26C. The first effort, begun on January 6, was "a drilling operation on a number of small clamps for the Plexiglas nose of B-26C bombardier compartments."[75] Work increased steadily as more equipment arrived, aided by the efforts of an expediting department.

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[71] Ibid., 31-33, 49, 53, 55.
[72] Larson, "Nebraska's World War II Bomber Plant," 34.
[73] Corps of Engineers, "Addendum No. 1 to Facilities Inventory A-A-Plant, Fort Crook Nebraska," 1944 (55th Wing Archives, Offutt Air Force Base),.index pt. II, sect. 3, 98.
[74] "History of the Glenn L. Martin-Nebraska Company," 56.
[75] Spickermann, ed., "History of Building 'D'," 5; and "History of the Glenn L. Martin-Nebraska Company," 57.

Martin-Nebraska Company also had to overcome some major obstacles regarding the delivery of subassemblies. One of these was coordinating the transportation of subassemblies from the many suppliers. Nebraska was 750 miles away from its nearest supplier, so coordination was imperative and relied almost entirely on the railroad industry. Burlington transportation experts worked closely with Martin-Nebraska to solve the problems. During construction, rail spurs were built for the plant, giving freight trains direct access to the fully enclosed dock areas of the assembly building. Burlington then customized a fleet of freight cars to accommodate the large subassemblies. Rolling cradles were installed in the cars to facilitate loading and unloading and some cars had raised roofs to make room for the exceptionally large wing assemblies.[76]

The list of subcontractors and subassemblies was extensive. Chrysler supplied nose and center sections of the fuselage and forward and aft bomb bay doors. Goodyear supplied outer wings, cowl, nacelle and landing gear doors as well as minor assemblies including ailerons and flaps. Hudson built the tail section of the fuselage and camera doors. Delco supplied landing gear. U.S. Rubber supplied Mareng cells, Solar-Budd made exhaust systems and Air Associates supplied spinners. Martin added to these its own assemblies including engine and plane controls, engine bearer and support, fuel and oil systems.[77]

On February 6, 1941 the Army Air Corps directed the Martin-Nebraska facility to be put to use as a modification facility. Sixty aircraft a month were to be modified for use by the U.S. and the British. The first aircraft, a B-26A, arrived for modification on February 10. Martin finally put to work some of the hundreds of employees that had been on hold or in training due to the lack of equipment.[78] Use of the assembly building for modification eventually caused additional delays in the assembly of B-26Cs. Shortages of materials meant that parts intended for new B-26C production were used to modify existing B-26As and B-26Bs. Modification projects continued to take place in the assembly building after the assembly of B-26Cs began in June, 1942. Consequently, even though the assembly building was declared 100 percent complete and equipped on April 30, full scale production of new B-26Cs was not possible until after the dedicated modification facility was completed in the fall of 1942.[79]

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[76] Spickermann, ed., "History of Building 'D'," 5-6.
[77] "History of the Glenn L. Martin-Nebraska Company," 76.
[78] Ibid., 72.
[79] Ibid., 83, 105.

The fall of 1942 saw continued delays in production. While the army was congratulating Martin-Nebraska for the delivery of 114 modified B-26Bs in just one month and "in spite of severe handicaps", Martin-Nebraska was being criticized for being behind on the production of new B-26Cs.[80] In addition there were change orders to deal with.

The aircraft industry was essentially a custom industry. Even with high production demands, the design changes continued. This made aircraft modification centers indispensable so that aircraft could be produced in quantity and then modified at a separate facility. However modifications were quickly incorporated into the original production line to prevent back ups at the modification centers. Martin-Nebraska was not only being asked to modify the design of the B-26Cs they were assembling; they also received change orders on the Martin gun turrets they were designing, producing and shipping to other aircraft manufacturers.

Finally a huge delay was caused when a change was made to the B-26 wing design. Goodyear was supposed to have been given new specifications for the wing design in August 1941, but did not receive them until January 1942. Goodyear spent months retooling to accommodate the wing design change. The first wing assemblies did not arrive until July 30, 1942. Wing assembly deliveries failed to keep pace with fuselage assembly up to the end of September.[81] A similar situation occurred later with Hudson's tail assemblies.[82]

Add to all of this the fact that the B-26C Executive Committee was not formed until September 1, after the Goodyear problem had nearly resolved itself. The committee, headed by the Martin Company, was to facilitate coordination between the various production entities. It was modeled after the very successful BDV (Boeing, Douglas, Vega) committee formed to coordinate production of the B-29. However the Army and Wright Field were not pleased with the performance of the B-26C Executive Committee, blaming it and Martin's Baltimore headquarters, for most of the production delay

[80] Ibid., 107, 123.
[81] Ibid., 98.
[82] Spickermann, ed., "History of Building 'D'," 7.

problems.[83] Thus, by the end of 1942, Martin-Nebraska had modified hundreds of B-26As and B-26Bs, but only assembled 110 new B-26Cs.[84]

The last months of 1942 saw the modification program, which was totally unplanned, with the space it needed. Two additional hangers were added to Hanger No. 1 of Modification Building A to accommodate the growing volume of the program.[85] By January 1943 the modification bottle neck and most of the delivery problems were solved. Serious production of B-26C Marauders finally began.

By the end of the year production had reached a peak of 125 new aircraft a month, for seven months.[86] Martin-Nebraska completed its original order for 1,200 B-26Cs in November. In December it was awarded the Army-Navy "E" Production Award for twelve months of production on schedule. The "E" stood for "excellence". It was during this peak of B-26C production, in July, that Martin-Nebraska found out it would be shifting to the production of a new aircraft in 1944, Boeing's B-29.[87]

B-29 PRODUCTION AT MARTIN-NEBRASKA

On January 29, 1940, the Army issued, for competitive bid, specifications for an experimental very heavy long-range bomber. Boeing Aircraft, who already had designs for several long-range bombers on its drawing boards, was one of several companies that responded. Boeing signed a contract with the Army to produce prototypes of the XB-29 in September, 1940.[88]

On July 16, 1943, during the seven month period of peak B-26C production, Martin-Nebraska announced that it would be phasing out production of the B-26C to accommodate a new government contract for production of Boeing's B-29. Construction of an addition to the existing manufacturing and assembly building began a month later on August 27.

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[83] Holley, *Buying Aircraft*, 546; and "History of the Glenn L. Martin-Nebraska Company," 123.
[84] "History of the Glenn L. Martin-Nebraska Company," 124.
[85] Ibid., 105, 120.
[86] Ibid., 124
[87] Spickermann, ed., "History of Building 'D'," 7-8.
[88] Robert F. Dorr, *US Bombers of World War Two*. (London: Arms and Armour, 1989). 142, 146.

The 135,000 square foot addition was designed by the Omaha architecture firm of John Latenser and Sons. Latenser and Sons was hired as architect for the Martin-Nebraska plant's buildings following Kahn's death in 1942. John Latenser and Sons also designed the modification buildings mentioned previously. John Latenser, Sr. (1858-1936), founder of the firm, is most noted for his design of two classically styled Omaha landmark buildings: the Douglas County Courthouse (1909-1912) and Central High School (1900-1912).[89]

The $2 million addition was a two story volume in which Martin-Nebraska workers built center wing sections from scratch. The wing sections were then hoisted up onto the existing main assembly floor of the plant where they were added, along with other wing parts, to the fuselage during the final steps of the assembly process. Besides requiring additional space, assembly of the B-29 also called for higher clearance than the existing structure provided. "The roof trusses were raised, but rather than alter the main doors, tractors hauled B-29s out of the plant with their nosewheels jacked up three feet so the tail ducked down low enough to fit through."[90] Putting together a new aircraft also meant significant retooling of the assembly line. Martin-Nebraska rose to the occasion by designing the first completely mechanized continuous conveyor system ever used for the assembly of B-29s. All of this work took place while workers continued to assemble B-26Cs, gradually tapering off production quantities until the last unit left the assembly building on Tuesday, April 4, 1944. Production on the B-29 began almost immediately afterward, on April 6. The first B-29 was completed on May 24, one month ahead of schedule, and was accepted by the Army Air Corps on May 31.[91]

Like the B-26C, B-29 production required the careful coordination of many players. "Chrysler supplied nose sections, nacelles, leading edges, and center wing flaps... Goodyear, in Akron, Ohio, built bomb-bay fuselage sections and Hudson Motor of Detroit provided fuselage waist sections and tail gun turrets... J. Case, the tractor and farm equipment-maker, supplied outer wing panels, wing tips and ailerons, and tail

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[89] Spickermann, ed., "History of Building 'D'," 7; and *John Latenser*, Omaha Landmarks Association. Internet on-line. Available from <http://www.ci.omaha.ne.us/landmarks/designated_landmarks/architects/latenser.htm>. [14 October 2002].

[90] Jacob Vander Meulen, *Building the B-29*. (Washington, D.C.: Smithsonian Institution Press, 1995), 70.

[91] Spickermann, ed., "History of Building 'D'," 8; "Chronology of Fort Crook", entry 1944; and Vander Meulen, *Building the B-29*, 70.

parts."[92] As with the B-26C, railroad cars were specially modified to carry the subassemblies to Nebraska.[93]

Also as with the B-26C there were early problems in communication and coordination between key players. In late 1943, as Martin-Nebraska was in the process of converting its assembly line to B-29 production, Martin took over the Fisher Company's B-29 contract. Two problems arose. First "nearly half of Fisher's blueprints and data sheets proved so specialized that Martin engineers couldn't understand them." Second the subcontractors who had agreements with Fisher refused to transfer those agreements to Martin. They were so worried that production of the B-29 would fall through, they insisted on an entirely new set of contracts to protect them from such a contingency. Since Martin managed to produce a finished B-29 a month ahead of schedule, these details proved to be more of a nuisance than a real hindrance to production.

Martin-Nebraska won more production awards. Two more Army-Navy "E" awards were given to Martin-Nebraska for on-time production of the B-29.[94] Because of this Martin-Nebraska was selected to produce and modify twenty B-29s for the Army's top secret project, Silver Plate.[95]

B-29 ASSEMBLY PROCESS

The B-29 assembly process began with the splicing of the nose and forward fuselage sections and the attachment of landing gear before being placed on the main assembly line. There the center wing section, manufactured in the Wing Assembly Annex, was hoisted into place by crane. As the B-29 moved down the first assembly line on link-belt conveyors, the wing flaps, ailerons, controls, instruments, and engines were installed. At the end of that production run, the B-29 moved to a turntable where it was rotated 180 degrees to face the opposite direction before proceeding down the next production line.

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[92] Vander Meulen, *Building the B-29*, 70.

[93] Spickermann, ed., "History of Building 'D'," 8.

[94] Ibid., 8-9.

[95] Ibid., 9.; Vander Meulen, *Building the B-29*, 73; and Daniel J. Hoisington, "Offutt Air Force Base and the Cold War" (National Park Service Historic American Engineering Record, Library of Congress, 2000), 13. Other sources disagree on the actual number of B-29s modified to carry the bomb. "Plant Here Readied 30 B-29s for A-Bombing," states a 30 July 1947 *Omaha World Herald* article. The Glenn L. Martin Aviation Museum website's Martin-Built B-29, states that the number was 50.

On the second assembly line, the tail assembly with stabilizer flaps and elevators were attached to the rear fuselage before being spliced to the plane. At the end of that run, the B-29 was rotated 90 degrees for the final assembly line where the outer wing splice and propellers were attached. The B-29 then rolled out of the Assembly Building to the Paint Shop. From the Paint Shop, the aircraft went down Runway No. 1 to the Modification Hanger for installation of armaments before heading to the Test Fire Pit at the end of Runway No. 3. The B-29 was then ready for its initial test flight.

WORK AT THE MANUFACTURING AND ASSEMBLY BUILDING

A typical day of work at the Martin-Nebraska Bomber Plant Manufacturing and Assembly Building was probably not much different from work at any other large manufacturing facility in the mid-twentieth century U.S. The differences that did exist had more to do with the urgency of the war effort than quantifiables like health benefits, parking, wage policies and cafeteria services. From the first Martin-Nebraska had all the trappings of a business that had come to stay, not the temporary employer it proved to be. Glenn Martin probably did believe, or at least hope, that his Nebraska plant would become a permanent production facility for his company. His philosophies on peace time production of armaments gained favor in the Army with each successive year of U.S. involvement in World War II. Albert Kahn and John Latenser and Sons certainly had designed the plant to last. Even if the plant was not operated by Martin, the Omaha and Council Bluffs communities were optimistic that it would be put to some sort of production use after the war. Adding to this feeling of permanence was the fact that the bureaucracy that existed at the Martin Plant in Baltimore was easily transferred to the Nebraska organization.

Workers entered the manufacturing and assembly building on the lower level, where all of the employee support spaces, like restrooms and cafeteria, were located. From there they proceeded up to the main assembly floor, taking the set of stairs nearest their work station. This was a typical Kahn design feature, intended to keep shift change traffic in the main assembly area to a minimum. Employees would remain busy at their stations until lunch or break times when they proceeded down the same set of stairs they came up, to get to the cafeteria. Restrooms were strategically located near stairs on the lower floor to minimize the distance that employees had to walk for breaks, thus reducing time away from production.

Every step of each employee's job was carefully described in a written document. If a faster way to complete a given task was discovered, or the steps to complete the task changed for some other reason, paper work had to be filed and distributed through the proper channels before the change could take effect. Equipment and supplies were carefully tracked from ordering to arrival to their use in assembly or modification.[96]

Martin had a reputation for treating his employees well. Kahn was known for designing buildings that created environments that were as healthy and comfortable for the production worker as possible. Special events like a free fried chicken dinner on Labor Day, 1942, and a performance by Abbott and Costello on July 30, 1942 were provided by Martin-Nebraska to keep employee moral up in spite of the long hours of work and serious news about the war. President Franklin Roosevelt even visited the plant. Roosevelt, along with Glenn Martin, Nebraska governor, Dwight Griswald and G. Tom Wiley, toured the building during the peak of B-26C production, on April 26, 1943.[97]

The tragedy of war was brought even closer to home when, on September 22, 1943, at about 1 p.m. a B-25 Mitchell bomber, at Martin-Nebraska for modification work, crashed through the roof of the Manufacturing and Assembly Building during a test flight. The plane crashed into a B-26C on the assembly line, destroying it. The ammunition on board the B-25 exploded as the plane burned, damaging several other B-26Cs. Three of the crew members were killed, the fourth seriously injured.

Fortunately, all of the assembly line employees were at lunch when the accident occurred. Had they been working, the loss of lives would have been much greater. The plan crash put Kahn's design for the building, which was supposed to be bomb-proof, to the test. The structure all around the impact area held. The crash resulted in no more than a relatively small seventy-five foot breach in the huge roof of the assembly building. The crash of the B-25 was the only serious accident to happen at the plant.[98]

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[96] Douglas County Historical Society Martin-Nebraska Bomber Plant file.
[97] Spickermann, ed., "History of Building 'D'," 6
[98] Ibid., 8; and Godfrey, "National Register of Historical Places Registration Nomination for Glenn L. Martin Nebraska Bomber Plant National Historic District," 13, footnote #24.

The B-26 and the B-29 in World War II

THE B-26 *MARAUDER*

In 1939 the Martin Company responded to an Army sponsored design competition for 385 units of a high-speed medium-range bomber. Specifications called for an aircraft which could reach speeds of up to 350 miles per hour while carrying a bomb load of 4,000 pounds. Martin's Model 179 won the competition. The design incorporated several advanced features including tricycle landing gear, shoulder-mounted wings, under slung engine nacelles, tailplane dihedral, an all-plexiglas nose cone, all-electric bomb-release system, powered gun turret, four-bladed propellers, and the latest Pratt and Whitney R-2800 engines.[99] The design facilitated rapid assembly by using large, welded aluminum forgings. To increase the aircraft's speed, the wings were made exceptionally small.

By the time the Martin-Nebraska plant was ready for production, the aircraft design had been through numerous modifications under the designations B-26A and B-26B. It was the B-26C that was produced at Fort Crook. One of the most notable changes was the increase in wing span, from 65' to 71', which was necessary to accommodate the increased weight caused by other design modifications, such as added armor plating to protect the crew. 5,611 B-26s of all types were produced at Martin's Baltimore plants. 1,585 B-26Cs were produced in Nebraska for a total of 7,196 aircraft.[100]

In its early years of service the B-26 was known by unflattering names including the *Widow Maker* and *Flying Coffin*. The nicknames were largely the result of two incidents. The high landing speeds and tricycle landing gear of the *Marauder* made them difficult craft for inexperienced pilots to handle. The result was a number of fatal training crashes at McDill Field in Tampa, Florida. The training program was improved and the accidents ceased, but the bad reputation lived on. The second incident was a disastrous operation of the 322nd Bomb Group in Europe. On May 17, 1943, Colonel Robert M. Stillman led ten *Marauders* on a mission against a power station at Ijmuiden, Holland. All ten *Marauders* were lost to anti-aircraft fire and Luftwaffe fighters. Only two crewmen

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[99] Glenn L. Martin Aviation Museum, "Martin 179, 182, 190, 205." Internet on-line. Available from <http://www.marinstateairport.com/museum/aircraft/ch_15>. [20 June 2002].
[100] Holley, *Buying Aircraft*, 578.

survived. Even though the failure of the mission could not be attributed to a design flaw in the B-26, it further tarnished the aircraft's reputation.[101]

In addition to the war in Europe, the B-26 was used in limited numbers in the war against Japan by the 22nd Bomb Group in New Guinea and the Aleutians. Four were used at the battle of Midway against the warships of Admiral Yamamoto. They were used extensively in North and South Africa by the U.S. and the British Royal Air Force. Lyndon B. Johnson became the most famous B-26 pilot. He won the Silver Star for a mission in New Guinea.[102]

Production of the B-26 ended in Nebraska in 1944 and in Baltimore in 1945. Because they were considered obsolete, many B-26s were destroyed after the war ended. Consequently few survive today. One of the best known, a B-26B named *Flak Bait*, is on display at the National Air and Space Museum. It survived 202 missions.[103]

THE B-29 *SUPERFORTRESS*

The B-29 was designed and built with the sole purpose of bringing the war to Japan without the use of ground forces. To achieve this goal, it incorporated several design firsts. It was the first bomber with a pressurized cabin. Its skin was designed with surface-flush bolts to eliminate drag and to increase fuel efficiency for longer flights with lighter fuel loads. It was the largest plane yet designed with a wing span of 141' and fuselage length of 99'. Its maximum speed was 358 miles per hour at 25,000', and it could reach elevations as high as 31,850'.[104] B-29's were built by three manufacturers at four plants throughout the U.S. Martin-Nebraska produced 515 B-29s. The nation-wide total was 3,760.[105]

Like the B-26, and most planes which were rapidly developed for use in World War II, the B-29 had some problems. The most persistent of these were engine fires. The engine problems were never completely overcome, afflicting the planes through the end of the war. Bomb groups flew missions over Japan from air bases established in China and the

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[101] Ibid., 50; and Glenn L. Martin Aviation Museum, "Martin 179, 182, 190, 205." Internet on-line.
[102] Dorr, *US Bombers of World War Two*, 55.
[103] Glenn L. Martin Aviation Museum, "Martin" 179, 182, 190, 205. Internet on-line.
[104] Dorr, *US Bombers of World War Two*, 144-145.
[105] Ibid., 147; and Holley, *Buying Aircraft*, 576-578.

Pacific's Marianas Islands. The first missions were a series of devastating incendiary strikes including one on Tokyo in March, 1945, which caused... destruction greater than that of both subsequent atomic bombs put together. Germany surrendered in May of 1945. Unfortunately, despite attacks such as these, Japan chose to stay in the war.[106]

The single most important contribution of the Martin-Nebraska Manufacturing and Assembly Building to the World War II effort was the construction of the B-29s which would be used in Project Silver Plate, the U.S. plan to drop the world's first atomic bombs on Japan. After the planes were constructed in the Assembly Building, they were modified in the Martin-Nebraska modification hanger to carry the atomic bombs. The mission was flown by the specially trained 509th Composite Group led by Colonel Paul Tibbets. Tibbets hand picked his B-29 from the group and named it *Enola Gay* for his mother. On August 6, 1945, he dropped the first bomb, nicknamed *Little Boy*, on Hiroshima. Three days later Major Charles Sweeney flew his B-29, named *Bock's Car*, toward Kokura, Japan. Bad weather over Kokura forced Sweeney to change targets and the second bomb, *Fat Man*, was dropped on Nagasaki. Japan surrendered unconditionally on August 15, 1945. After the war ended the B-29 *Superfortress* was kept in active use, serving in the Korean War in the 1950s.[107]

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[106] Dorr, *US Bombers of World War Two*, 146-150.

[107] Ibid., 153-155; and Hoisington, "Offutt Air Force Base, Strategic Air Command Headquarters and Command Center, Headquarters Building," 4.

After World War II

THE GLENN L. MARTIN COMPANY

Difficulties with the production and performance of the B-26 and with the initial production of the B-29 left Martin again at odds with the Army, despite Martin-Nebraska's excellent overall performance record. By 1949 Martin was forced to step down as president of his own company. New investors replaced him as CEO and elected Martin to chairman of the board.[108] Martin's influence in his company continued to wane until he retired in 1952. He died three years later in 1955.[109]

After World War II, the Martin Company moved into the design and production of missiles for the military. One of the most successful was the Pershing Missile program, a series of missiles began in 1958 which continued for thirty-four years. In the early 1960s Martin merged with American-Marietta Company and became Martin-Marietta. Martin-Marietta used its missile experience to become a top contractor for the U.S. space program, participating in the construction of both the space shuttle and skylab. In 1995 Martin-Marietta merged with Lockheed to form today's Lockheed Martin Corporation, one of the largest aerospace, defense and technology companies in the world.[110]

ALBERT KAHN AND ASSOCIATES

Albert Kahn did not live to see the effect his factories had on the outcome of World War II. With a day's work often stretching close to the 24-hour point, the strain of so much war work is said to have taken a toll on Kahn. His long, prolific career ended in 1942 with his death at the age of 73 without ever retiring.[111]

The firm continues as Albert Kahn Associates, Inc. with its main office in Detroit, Michigan. The firm's annual volume of work in 2002 was one billion dollars in construction costs. Albert Kahn Associates (AKA) is "an award-winning planning, design and management firm of the built environment, serving industrial, healthcare, commercial, educational, and government clients worldwide."[112]

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[108] Biddle, *Barons of the Sky*, 308.
[109] William H. Longyard, *Who's Who in Aviation History*, (Novato, CA: Presido Press, 1994), 123-124.
[110] "1940-2000", *History Timeline*. Lockheed Martin Corporation. Internet on-line. Available from <http://www.lockheedmartin.com/about/history.html>. [14 August 2002]
[111] Van Vynckt, *International Dictionary of Architects and Architecture*, vol. 1, 452.
[112] <http://www.albertkahn.com/kahn.cfm>. [14 August 2002]

USE OF THE MANUFACTURING AND ASSEMBLY BUILDING

Immediately following Japan's surrender the Martin-Nebraska Bomber Plant closed for three days, giving employees some badly needed time off.[113] Employees were gradually laid off and production of the B-29 was drastically reduced until the last plane left the assembly building on September 18, 1945. Unfortunately, the success of the Nebraska plant could not compensate for Martin's deteriorating relationship with the Army. Martin did not have enough post-war work to continue operation of Martin-Nebraska.

Subsequent use of the plant stirred up a great deal of controversy. Omaha and Bellevue communities wanted to see the plant sold to a private company which would continue to use it as a manufacturing facility. Such a use would insure employment for as many as 6,000 to 8,000 residents, strengthening the local economy and providing jobs for many of the Martin-Nebraska workers who were laid off when the war ended. However, despite interest in the plant by companies like LeTourneau out of Peoria, Illinois, the Army had other plans for the plant.

The post-war advent of an independent Air Force and the Strategic Air Command (SAC) was the result of a new U.S. policy towards war. The policy was one of on-going military readiness. This policy determined the initial reuse of the plant as an equipment storage facility. Rather than sell off the millions of dollars of equipment the military had invested in weapons manufacture, the equipment was catalogued and stored in the Martin-Nebraska Manufacturing and Assembly Building and Bell's Marietta, Georgia plant for future use. The storage program was part of the Air Industrial Preparedness Program.[114] The two plants stored approximately 40,000 tools valued at $400 million as of 1951. The tools were divided about equally between the two plants.[115] Instead of employing thousands of workers, the storage facility provided work for less than 500.[116]

The community continued to rally for private use of the plant for years after the war to no avail. The Air Force argued that private use of the plant would make security for SAC difficult.[117] SAC moved its headquarters into the plant's administrative buildings in 1948, the same year Fort Crook was renamed Offutt Air Force Base. SAC grew from

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[113] "Martin, Mead to Dribble Out." *Omaha World Herald.* 17 August 1945.
[114] "Army Avers Martin Storage War Lesson." *Omaha World Herald.* 20 August 1947
[115] "Bomber Plant Study Hinted." *Omaha World Herald.* 12 October 1951.
[116] "Martin Plant Stores Tools." *Omaha World Herald.* 24 October 1946.
[117] "Missiles Plant Being Sought." *Omaha World Herald.* 15 February 1955.

occupying a single building to occupying three buildings, plus a portion of the Manufacturing and Assembly Building. Almost immediately after SAC moved into its new headquarters building, in 1957, the plant was once again put to use as a manufacturing facility.[118]

By the time SAC moved into its new purpose-built Offutt Air Force Base headquarters, the Soviet Union had developed nuclear capabilities and the Cold War was underway. In 1955, President Dwight D. Eisenhower announced that missile production was the nation's highest priority.[119] The Omaha World Herald began publishing stories about the possibility of the old Martin-Nebraska bomber plant being converted into a missile manufacturing facility as early as 1955.[120] By 1959, the rumors became fact. Bids were opened up for renovation of the Assembly Building for missile production. Guided missiles were assembled at the facility until 1965.[121]

Since 1965, the vast spaces of the Manufacturing and Assembly Building have gradually been subdivided to house many functions of differing sizes. By the mid 1980s it housed as many as fourteen different functions for Offutt Air Force Base including: Air Force Global Weather Central, the largest weather monitoring facility in the world; the Fifty-fifth Strategic Reconnaissance Wing and Avionics Maintenance Squadron's Precision Measurement Equipment Laboratory; the 3902d Supply, Civil Engineering and Transportation Squadrons; the 3428th Technical Training Squadron; 544th Target Materials and Intelligence Exploitation Squadrons; the 1000th Satellite Operations Group; a post office; printing plant; publication distribution office; barber shop; Education Services Branch; three tennis courts and a wood shop. The bomb-proof building also serves as a civil defense shelter and storage area should the air base ever come under attack.[122]

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[118] Hoisington, "Offutt Air Force Base, Strategic Air Command Headquarters and Command Center, Headquarters Building," 13.
[119] *U.S. Nuclear History: Nuclear Arms & Politics in the Missile Age, 1955-1968.* The National Security Archive of George Washington University. Internet on-line. Available from <http://www.gwu.edu/~nsarchiv/nsa/publications/nh/>. [30 November 2002].
[120] From the following *Omaha World Herald* articles: "Missile Plant Being Sought," 15 February 1955; "Plan to Make Missiles Here," 19 May 1955; "Sell Points for Missile Site Listed," 24 July 1955.
[121] "History of Building 'D'," 11.
[122] Ibid.

Conclusion

Today the Martin-Nebraska Bomber Plant Aircraft Manufacturing and Assembly Building seems humble despite its impressive size. Years of wear and tear and alterations, especially the painting over of its acres of windows and monitors, have diminished its visual impact upon the observer both inside and out. Its critical role in World War II is not widely known or celebrated, even locally. Yet Martin-Nebraska changed Nebraska and the world forever.

The Martin-Nebraska Bomber Plant marked the end of an era for Glenn L. Martin and the end of a career for Albert Kahn. Post-war, the Martin Company continued to play a key role in aerospace history. Martin-Nebraska, one of the last plants Kahn designed before his death in 1942 was one of a series of three plants built for the same purpose. It was an example of how continual innovation made Kahn the most sought-after industrial architect of his era. It was the Manufacturing and Assembly Building's ultimate use for the production of the *Enola Gay* and *Bock's Car* that made it the most historically significant building in both Glenn L. Martin's and Albert Kahn's careers. It is this distinction too that sets it apart from every other manufacturing plant in the world.

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